surgical repair in the neonatal period. BA is safe and effective in relieving restenosis with a success rate at intermediate follow-up of 95%, in our series, with 80% of patients requiring only one such procedure.

954-146 Sinus Node Dysfunction Following Modified Fontan Operation (Total Cavo-Pulmonary Connection)

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Background: The modified Fontan operation, or total cavopulmonary connection has been a commonly employed palliative surgery for children with single ventricle physiology. Preservation of sinus node function may be especially important following this operation. We evaluated the short-term and intermediate-term effects of the modified Fontan operation on sinus rhythm using 24 hour Holter monitoring.

Methods and Result: From January 1992 to April 1995, 27 patients underwent the modified Fontan operation. Their mean age at the time of surgery was 2.9 ± 0.75 years. Holter monitors were obtained the day prior to surgery, the day prior to hospital discharge, and a minimum of 9 months after surgery. The results were compared to 21 patients undergoing secundum ASD repair, who also had pre-operative and pre-discharge Holters. All patients were in sinus rhythm prior to surgery. Pre-discharge Holter monitors demonstrated sinus rhythm in all patients following ASD repair. Of those undergoing modified Fontan repair 77% (20/26) were in a sinus or atrial rhythm and 23% (6/26) in junctional rhythm post-operatively ($p = 0.01$). Intermediate-term Holters obtained in 22 patients 3.2 ± 1.2 years (mean ± SD) after a modified Fontan repair demonstrated that the incidence of junctional rhythm increased to 41% ($p < 0.001$). Two patients with junctional rhythm developed signs and symptoms of moderate to severe congestive heart failure 4–6 weeks after the surgery which resolved by re-establishing atrial ventricular synchrony with permanent atrial pacing. For patients undergoing a modified Fontan repair there was a significant decrease in average awake heart rate (98 ± 10 vs 115 ± 13, $p < 0.001$) in the intermediate-term post-operative Holter when compared to the pre-operative study. This was also true for average sleeping heart rate (74 ± 13 vs 99 ± 11, $p < 0.0001$), maximum heart rate (142 ± 21 vs 158 ± 21, $p < 0.04$) and minimum HR (57 ± 14 vs 71 ± 13, $p < 0.005$).

Conclusion: Sinus node dysfunction is a common complication of the modified Fontan operation and may worsen with time. It frequently results in chronotropic incompetence and loss of atrioventricular synchrony.

954-147 "Atrioventricular Groove" Tachycardias in Small Children: Clinical Characteristics and Treatment Strategies

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This study examines the clinical characteristics and management options in a group of 4 small children (3 f, 1 m; ages 1–21 mos at presentation) who had both complex atrial and ventricular arrhythmias. The substrate responsible for these arrhythmias most likely involves tumor(s) which traverse the AV groove. All 4 pts had WPW on their EKG at presentation. Initial tachycardias were orthodromic SVT (2), antidromic SVT (1), and VT (1). Three out of the 4 patients had catastrophic episodes of VT with cardiac arrest and/or death. Tumors involving the AV groove were identified by imaging in 2 of 4 pts (MRI and echo). AV groove substrates were confirmed in the other 2 pts by EP data obtained at catheter ablation procedures. Three of the 4 pts are alive and well. One child died suddenly at home from VT on amiodarone and flecainide 6 mos following successful surgery for WPW. One pt was successfully treated with intensive drug therapy (combination Class I, II and III drugs) for VT after the resolution of the WPW syndrome. Two pts were successfully treated with catheter ablation. One of these pts had WPW ablated, but PVCs emanating from the "ventricular end" of the substrate persist. The other pt had WPW and VT originating from the anterior septal region successfully ablated after presenting with cardiac arrest and 6 months of ineffective in-hospital medical treatment of VT. *Conclusion:* Small children with WPW may have complex, lethal atrial and ventricular arrhythmias secondary to tumors traversing the AV groove. Aggressive therapies may be needed to control symptoms and avoid sudden cardiac death.

954-148 The Effects of Verapamil on Fetal Cardiac Mechanics

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Calcium channel blockers may be utilized during pregnancy as a maternal or fetal antiarrhythmic or tocolytic agent. Since the t-tubule and sarcoplasmic reticulum are not fully developed in the fetal heart, it is likely that the negative inotropic effect of calcium channel blockers will be exaggerated in the fetus.

The effect of verapamil on fetal cardiac contractile mechanics was studied in 5 fetal hearts (135 days gestation) employing an isolated isovolumetric contracting preparation. The systolic and diastolic volume-pressure relationship was determined before (control) and after the infusion of subclinical and clinical levels of verapamil.

Verapamil blood levels obtained were sub to low therapeutic in each case (87–146 μg/L). The peak left ventricular developed pressure (LVPDP) and enddiastolic pressure (LVEDP) at a physiologic 5 mm Hg preload were significantly reduced even when verapamil levels were subclinical. The volume-pressure curve was shifted downward.

	Control (mean ± SEM) (mm Hg)	Verapamil Hg) (mean ± SEM) (mm Hg)	p-value
LVEDP	18.4 ± 1.2	9.6 ± 1.5	n.s
LVPDP	65.8 ± 2.4	19.3 ± 2.0	< 0.05

We conclude that Verapamil exerts a severe negative inotropic effect on the fetal heart, far greater than expected from the adult literature. Since we and others have demonstrated placental transfer of verapamil, its use in the pregnant female is relatively contraindicated. Also, since the neonatal heart most likely represents a transition between the fetal and mature myocardium, its use in the pregnant females and neonates should also be questioned.

955 New Treatments for Cardiac Resuscitation

Monday, March 17, 1997, 3:00 p.m.–5:00 p.m.
Anaheim Convention Center, Hall E
Presentation Hour: 4:00 p.m.–5:00 p.m.

955-167 Right Ventricular Dysfunction Following Successful Resuscitation From Prolonged Cardiac Arrest

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Resuscitation following 10 to 15 minutes of untreated ventricular fibrillation results in a traumatic decrease in left ventricular systolic and diastolic function. To evaluate the effect of prolonged cardiac arrest and resuscitation on right ventricular function 28 swine, 16 control animals and 12 which received Dobutamine (10 μg/kg/min) were studied for 5 hours post-resuscitation. Each was instrumented with solid state micromanometer-tipped pigtail catheters to measure right ventricular end-diastolic pressure and perform right ventricular angiography to calculate right ventricular ejection fraction. A 10 to 15 minute period of ventricular fibrillation followed by resuscitation was utilized. There were significant differences over time in both end-diastolic pressure and ejection fraction in the control group. Table 1 shows the differences at 30 minutes and 2 hours between animals receiving no treatment and those receiving Dobutamine.

	Controls	Dobutamine	"p"
RVEDP (mmHg)			
Baseline	5 ± 1	4 ± 1	0.88
30 min.	8 ± 1	4 ± 1	0.004
2 hr.	4 ± 1	4 ± 1	0.84
5 hr.	5 ± 1	3 ± 1	0.23
RVEF (%)			
Baseline	50 ± 2	50 ± 2	0.97
30 min.	34 ± 2	42 ± 4	0.13
2 hr.	40 ± 2	49 ± 2	0.01
5 hr.	41 ± 2	47 ± 4	0.14

Prolonged cardiac arrest followed by successful resuscitation results in significant right ventricular dysfunction. Dobutamine can significantly improve this post-resuscitation right ventricular dysfunction.

955-168 Comparison of Epinephrine and Phenylephrine in Resuscitation From Cardiac Arrest Using Selective Aortic Perfusion and Oxygenation

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Purpose: To compare epinephrine (EPI) and phenylephrine (PHE) as intra-

aortic (I-Ao) pressors during ACLS-selective aortic perfusion and oxygenation (SAPO) with ultra-purified polymerized bovine hemoglobin (UPBH). *Methods:* Randomized, blinded, interventional study using a canine model of ventricular fibrillation (VF) with ACLS-SAPO resuscitation. After α-chloralose anesthesia, Ao blood gases and vital signs were normalized. ECG, Ao arch, and right atrial pressures were measured continuously. A descending Ao occlusion-infusion balloon catheter was placed through the femoral artery. VF was induced and BLS begun after 10 min. of arrest. Inter-animal differences in BLS were minimized by standardization of esophageal pulse pressure and Ao blood gases. After 13 min. of arrest, the Ao occlusion balloon was inflated and EPI [0.01 mg/kg] or PHE [0.5 mg/kg] administered I-Ao. This was followed by oxygenated UPBH (30 ml/kg) infusion over 2 min. and electrical countershock. *Results:* (n = 14) Three of 7 animals receiving EPI had ROSC versus 7 of 7 animals receiving PHE (p = 0.07). Two animals in the EPI group were alive one hour following ROSC versus all 7 animals receiving PHE (p = 0.02). The 4 animals in the EPI group that did not achieve ROSC defibrillated into pseudo-electromechanical dissociation. *Conclusions:* In this model 0.5 mg/kg of PHE in conjunction with ACLS-SAPO increased the survival rate at one hour, and tended towards improving rates of ROSC as compared to 0.01 mg/kg EPI.

955-169 Long Term Survival Rate After Resuscitation With the Use of Percutaneous Cardiopulmonary Support

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Percutaneous cardiopulmonary support (pCPS) offers the opportunity to reestablish circulation in patients (pts) who can not be resuscitated by conventional means. As of today, follow-up data of pts who were resuscitated using pCPS are still lacking. Between October 1990 and July 1996 pCPS was used in 32 pts in refractory circulatory arrest in our clinic (age 58 ± 10.4 years, 9 ♀, 23 ♂). 25 pts (78%) had acute myocardial infarctions, 2 (6%) pulmonary embolisms, 2 (6%) ventricular ruptures, 3 (9%) valve fractures. Standard resuscitation was performed over 10 to 240 minutes (59 ± 43 min) before stabilization by pCPS. In 3 pts (9%) we did not achieve sufficient circulation; in the other 29 pts (91%) cardiopulmonary support was maintained over 1.5 to 10 hours. 22 pts (69%) died in the clinical course due to multi-organ failure despite primarily successful catheter interventions or cardiac surgery. 7 pts (22%) were discharged from hospital without relevant disabling neurological defect. 3 of them had cardiac surgery (9%), in the other 4 pts a PTCA was performed (13%). The time of standard resuscitation before insertion of pCPS in those pts who were discharged from hospital was 42 ± 22.4 min (mean age 52 ± 7 years). After an average follow up of 30 months 4 pts (13%) are still alive. 2 pts died of cardiac failure and 1 pt of neoplasm during follow up. By use of pCPS in combination with interventional and surgical procedures it is possible to achieve a success rate of 22% if other means of resuscitation do not suffice. The relatively poor long term survival underlines the need for early complete revascularisation in those pts surviving the first ischemic arrest. Due to economic bending and the relatively poor long term survival rate the decision for using pCPS in resuscitation should be considered in young pts.

955-170 A Randomized Trial of Magnesium in Cardiac Arrest

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We conducted a randomized, double-blind trial comparing magnesium to placebo in the management of in-hospital cardiac arrest. Patients at least 18 years old in the general wards and intensive care units were eligible; exclusion criteria were advanced atrioventricular block and clinical indication for magnesium. The primary endpoint was return of spontaneous circulation (ROSC) defined by the attainment of any blood pressure or palpable pulse for at least 1 hour following cardiac arrest. Baseline clinical characteristics and initial rhythms were similar between the groups. In univariate and multivariate models only an initial rhythm of ventricular fibrillation or tachycardia was a predictor of ROSC or survival to hospital discharge. The results are indicated in the table:

Outcome	Magnesium n = 76	Placebo n = 80	OR	95% CI
ROSC	41 (54)	48 (60)	0.78	0.41–1.47
24 hr survival	33 (43)	40 (50)	0.77	0.41–1.44
Discharged	16 (21)	17 (21)	0.99	0.46–2.13
Karnofsky score	70%	40%	p = 0.041	

Values are expressed as number of patients (%)

Our study demonstrated no improvement in resuscitation, 24-hour survival, or survival to hospital discharge in hospitalized patients with cardiac arrest who were treated with empiric magnesium supplementation compared with placebo. Patients assigned to magnesium who survived to discharge had improved functional status as measured by the Karnofsky performance score.

955-171 Transthoracic Defibrillation Using a Novel 3 Electrode Configuration With Multivector Overlapping Pulses

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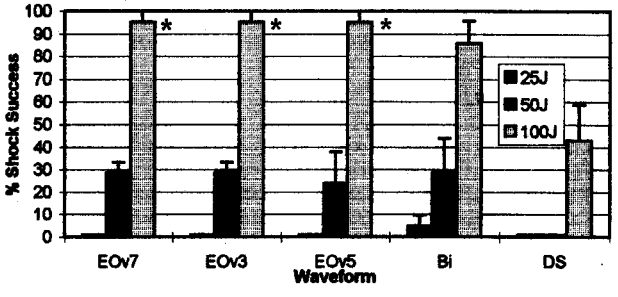
We have shown in experimental animals that encircling overlapping truncated exponential shock waveforms using 6 electrode pads placed around the chest improve shock success for ventricular fibrillation (VF). However, the need for multiple capacitors and a total of 6 electrode pads would make this clinically cumbersome. Our purpose was to evaluate the defibrillation efficacy of a new 3 pad electrode configuration using a single capacitor. Three new truncated exponential encircling overlapping waveforms were designed specifically for this configuration: 7 vector, 7 ms duration (EOv7); 3 vector, 6 ms duration (EOv3); 5 vector, 10 ms duration (EOv5). Damped sinusoidal (DS) and Biphasic single pathway 5 ms positive, 3 ms negative (Bi) waveforms were used for comparison. VF was induced and maintained unsupported for 15 seconds in 7 closed chest swine.



* $p < 0.05$, compared to DS, Mean ± SEM

Thus, novel multivector overlapping waveforms which can be delivered from a simple 3 electrode configuration are more effective than the standard damped sinusoidal waveform for transthoracic defibrillation.

955-172 Temporary Cardiac Pacing in CCU using Balloon-Flotation Electrode Catheters: a Randomised Comparison with Conventional Semi-Rigid Electrode Catheters

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Emergency transvenous cardiac pacing in the CCU is often performed by junior medical staff with limited invasive experience resulting in prolonged procedures and a high incidence of complications. Balloon-flotation (B-F) pacing catheters require less manipulation than conventional semi-rigid (S-R) electrode catheters and may be easier for less experienced operators to insert. We prospectively randomised 40 patients (20 M:20 F, mean age 72 yrs) undergoing temporary ventricular-demand pacing to S-R or B-F electrode catheters inserted with fluoroscopic guidance. Indications for pacing were AV block with acute MI (n = 16), AV block without recent ischemia (n = 19) and overdrive pacing for VT (n = 5). All procedures were performed by Residents/Fellows in Cardiology or Internal Medicine. End-points included procedure duration (excluding venous access), fluoroscopy time and diastolic threshold at implant/24 hrs. Catheter position was independently assessed from the post-insertion chest X-ray and categorised as satisfactory (Satis.) or suboptimal.

Cardiac pacing was established in all cases with a threshold ≤ 1.0 V at 2 ms pulse width (no difference between groups at implant/24 hrs). Complications in the S-R group were displacement (n = 3), RV perforation (n = 1) and in the B-F group were displacement (n = 1).

	Duration (secs)	Fluoroscopy (secs)	Satis. position
B-F	430 ± 150	153 ± 160	100%
S-R	870 ± 910	328 ± 300	60%
p value	< 0.002	< 0.01	< 0.001

Conclusions: Using B-F catheters resulted in shorter insertion procedures, with less fluoroscopy, better final catheter positions and fewer complications.

MONDAY POSTER